DOCUMENT RESUME

ED 061 337 TM 001 565

TITLE	Firesetter (elec. equip; electronics) 692.380--Technical Report on Standardization of the General Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	TR-S-133
PUB DATE	Nov 58
NOTE	8p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; Males; *Mechanical Skills; Norms; Occupational Guidance; *Personnel Evaluation; Test Reliability; Test Validity
IDENTIFIERS	Firesetter; GATB; *General Aptitude Test Battery

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is also included. (AG)

ED 061337

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TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

Firesetter (elec. equip. Electronics) 672.380

S-133

TM 001 565

U. S. Employment Service in
Cooperation with
the
Pennsylvania State Employment Service

U. S. DEPARTMENT OF LABOR

Washington , D. C.
November 1958

GATB #2186
October 1957

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 52 men employed as Units Mechanic 5-00.020 at the Sylvania Electric Products, Montoursville, Pennsylvania. The criterion consisted of rank order supervisory ratings. On the basis of the statistical and qualitative analysis of the data, Aptitudes G-Intelligence, K-Motor Coordination, and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for .

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	85	G	Part 3 Part 4 Part 6	80
T	CB-1-G CB-1-K	75	K	Part 8	80
M	CB-1-M CB-1-N	95	M	Part 9 Part 10	90

Effectiveness of Norms

The data in Table IV indicate that 9 of the 17 poor workers, or 53 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 53 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 33 of the 41 workers who made qualifying test scores, or 80 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of [illegible]

II. Sample

The General Aptitude Test Battery, B-1002A, was administered during the period October 3-10, 1957 to 55 men employed as [illegible] by the Sylvania Electric Products, Montoursville, Pennsylvania. Of the 55 workers tested, three were eliminated from the sample; two because of age and one was not employed as a Units Mechanic. Thus, the final sample consisted of 52 men.

Workers are not hired from outside the company for this job except in rare instances. On-the-job training is given by the supervisor. The minimum training time for inexperienced workers is estimated to be 36 months, and 6 months for workers with some experience. No special training records are kept on trainees.

Men are upgraded from lower level mechanical jobs to Units Mechanic. Qualified workers may be promoted to supervisor. Workers must pass a physical examination, and the company desires workers with a high school education or its equivalent. The company conducts an exit interview whenever an employee terminates his employment.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations with the criterion for age, education and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

N = 52

	M	σ	Range	r
Age (years)	37.3	7.2	25-54	-.404**
Education (years)	10.7	1.7	7-12	.320*
Experience (months)	63.2	31.8	11-162	.107

** Significant at the .01 level
* Significant at the .05 level

The negative correlation between age and the criterion and the positive correlation between education and the criterion may indicate a bias on the part of the supervisors in favor of the younger workers who probably have more education, or it may indicate that the younger workers with more education tend to be more proficient on the job. No significant correlation exists between experience and the criterion. The data in Table II indicate that this sample is suitable for test development purposes with respect to age, education, and experience.

III. Job Description

Job Title: FINISHER (73 350.

Job Summary: Sets up and maintains in operation, automatic lamp-making machines such as stem machines, exhaust machines, sealex machines, basing machines and transfer units. Starts machine by pressing buttons to start drive motors and observes operation of machines. Reads and analyzes production and statistical reports for evidence of shrinkage. Makes necessary adjustments and/or repairs. Computes production loss from shut down versus scrap loss from machine defects and determines need for additional repairs. Stops machine by pressing buttons to stop drive motors and closes valves to extinguish gas flames.

Work Performed: Sets up automatic lamp machines: Attaches required size arms, sockets or levers for size lamp to be made, following oral instructions, blueprints, and a memory of required sequence of actions and flow of heat. Attaches or adjusts head (a bulb holder which carries one lamp at a time past the flame or other part of the machine) parts with wrenches. Checks locations of parts of heads with plug or feeler gauges, and presses jog switch to make sure of free movement, taking care to keep hands and tools in clear. Attaches micro and wafer switches with hand tools along path of workpieces so missing pieces or jammed feeds will be automatically indicated by bell. Fills flux cups and solder and wire spools and threads solder and wire through guides manually.

Starts machines: Presses buttons to start drive motors. Turns valve handwheels to supply gas, air, and oxygen. Lights gas flames with tapers and adjusts valves to get correct flame color and size or to get correct solder flux color as indication of heat. Compensates for different distances between heat applications for A and B series of heads where necessary by adjusting valves so approximately equal temperatures are reached at point of solder application.

Observes operation of machines: Listens to machines to detect maladjustment or breakage. Smells and feels solenoids of solenoid valves to detect ones which stick. Looks for cracks in lamps, for lamps riding crooked in heads or for bases which do not rise high enough. Listens for bell indicating jam of bases in conveyor from syntron (part feeding machine). Watches for accumulation of scrap which might get in gears or otherwise interrupt production or be a safety hazard. Measures lacquer line of bulbs with gauge to determine whether internal lacquer is too far down. Watches gas flames for changes caused by fluctuations in supply pressure and turns handwheels to restore flames to proper dimension and color.

Reads and analyzes production and statistical reports accurately for evidence of shrinkage. From these reports determines possible location and type of malfunction to be rectified. Makes necessary adjustments and/or repairs.

Computes production loss from shutdown versus scrap loss from machine defects: Adds time for run-off, time for restart, and estimated time for part loss replacement and multiplies sum by production per minute to compute production loss from shutdown. Estimates number of scrap lamps to be produced before some other shutdown reason will provide an opportunity for repair or replacement. Decides from available evidence and past experience whether to stop machine.

Stops machine: Presses buttons to stop drive motors and closes valves to extinguish gas flames.

IV. Experimental Battery

All the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion consisted of rank order ratings made by the first line supervisor. The supervisor rated all of the workers, in rank order, September 20, 1957 and rerated them, in rank order, November 4, 1957. The rank order ratings were converted to linear scores and a Pearson product-moment correlation coefficient was computed between the two sets of ratings. The obtained correlation coefficient was .85. The linear scores for the two sets of ratings were averaged. The final criterion consisted of the averaged linear scores.

VI. Statistical and Qualitative Analysis

A. Statistical Analysis:

Table III shows the means, standard deviations, and Pearson product-moment correlations with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

N = 52

Aptitudes	M	σ	r
G-Intelligence	100.1	12.8	.124
V-Verbal Aptitude	96.8	12.6	-.054
N-Numerical Aptitude	98.6	15.5	.228
S-Spatial Aptitude	97.2	15.6	-.023
P-Form Perception	94.6	13.7	.232
Q-Clerical Perception	95.8	12.8	.445**
K-Motor Coordination	96.5	13.4	.388**
F-Finger Dexterity	102.4	14.9	.177
M-Manual Dexterity	111.2	20.2	.050

** Significant at the .01 level

The highest mean scores in descending order of magnitude were obtained for Aptitudes M, F, and G. All the aptitudes, except Aptitude M, have standard deviations of less than 20. For a sample of 52 cases, correlations of .354 and .273 are significant at the .01 level and the .05 level of confidence, respectively. Aptitudes Q and K correlate significantly with the criterion at the .01 level.

B. Qualitative Analysis:

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation.

Intelligence (G) - required to set up machines, to make determinations and judgments regarding the cause of defective production, to understand and interpret reports and instructions, and to understand the operating principles of the machines used.

Spatial Aptitude (S) and Form Perception (P) - necessary to read blueprints for machine set-ups and to inspect lamps during various stages of operation.

Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M) - necessary for turning, positioning, adjusting, and fingering hand tools and other accessories, for manually threading solder and wire through guides, and for quickly turning valves, hand wheels, levers, etc., to make necessary adjustments with minimum loss of time.

C. Selection of Test Norms:

Based on the quantitative and qualitative evidence cited above, Aptitudes G, K, F, and M warranted further consideration for inclusion in the test norms. The evidence for each of these aptitudes is indicated below.

Aptitude	Relatively High Mean	Significant Correlation with Criterion	Importance Indicated by Qualitative Analysis
G	X		X
K		X	X
F	X		X
M	X		X

Although Aptitudes S and P appeared to be important on the basis of the job analysis data and Aptitude Q had a significant correlation at the .01 level with the criterion, these aptitudes were not considered further for inclusion in the norms because there was no other qualitative or quantitative evidence of significance.

Various combinations of Aptitudes G, K, F, and M, with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in section VII) was determined.

A comparison of the results showed that norms consisting of G-80, K-80, and M-90 for B-1002 and equivalent norms of G-85, T-75 and M-95 for B-1001 had the best selective efficiency.

In test development studies an attempt is made to develop a set of norms such that the cutting score for each aptitude included in the norms will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 5 points of one standard deviation below the aptitude mean of the sample.

VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized by setting a criterion critical score of 41. This resulted in 17 of the workers, or 33 percent of the sample, being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes G, K, and M with critical scores of 80, 80, and 90, respectively, and the dichotomized criterion for FORESTER 672.590 . Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes G, K, and M with Critical Scores of 80, 80, and 90, Respectively, and the Criterion for [illegible]

N = 52

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	2	33	35
Poor Workers	9	8	17
Total	11	41	52

$r_{tet} = .83$ $\qquad$ $X^2 = 12.601$

$\sigma_{r_{tet}} = .25$ $\qquad$ $P/2 < .0005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes G, K, and M with minimum scores of 80, 80, and 90, respectively, are recommended as B-1002 norms for the occupation of FIRESETTER 699.380. The equivalent B-1001 norms consist of G-85, T-75, and M-95.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. The only one of the existing 23 occupational aptitude patterns which meets these criteria for this study is OAP-21 which consists of G-80, K-90, and M-80 for B-1002 and G-85, T-85, and M-80 for B-1001. The selective efficiency of OAP-21 for this sample was determined by means of the tetrachoric correlation technique. A tetrachoric correlation of .60 with a standard error of .23 was obtained, which indicates a significant relationship between OAP-21 and the criterion for this experimental sample. The proportion of the sample screened out by OAP-21 was .33, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-21 be used in counseling for the occupation of FIRESETTER 699.380.